

# Interchain Transesterification as a Solid-State Composite Welding Mechanism, Phase I

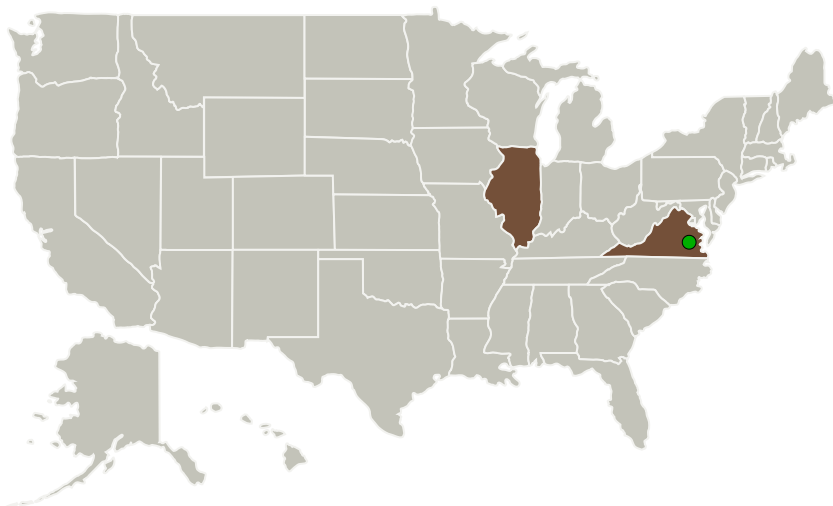
Completed Technology Project (2017 - 2017)



## Project Introduction

We will develop novel composite structures of carbon fiber reinforced high performance aromatic thermosetting copolyester (ATSP) resin composites (ATSP/C) being solid-state bonded to primary metal spacecraft structures in order to build lightweight elements with tailorable structural properties without necessitating additional uses of adhesives or mechanical joints. The ITR bonding approach uniquely enables chemical interfacial (surface) self-welding mechanism effectively consolidating pre-cured parts through a smooth strong and continuous bond line. The ITR bonding fully solid-state process, which eliminates approaches that rely on uncured polymer or a meltable interstitial phase. The ITR ensures physical integrity of joint members of the structure and the reversible adhesive within the range of temperatures experienced during day/night cycles in space. The ITR is the first viable composite welding scheme for fully cured thermoset composites. Tailorable ATSP chemistry can be adapted to nearly any polymer processing technique by adjustments in oligomer structure providing unique advantages compared to conventional polymer matrices. In Phase I, we will develop an out-of-autoclave fabrication method to produce solid-state bond consolidated carbon fiber reinforced ATSP composite laminae and ATSP coated aerospace grade metal substrates. Additionally, we will perform physical characterization, thermomechanical property measurements and performance analyses of ITR bonded specimens. Additionally, we will develop thermal-electrical-mechanical finite element analysis models for optimized composite design with tailorable physical properties.

## Primary U.S. Work Locations and Key Partners



Interchain transesterification as a solid-state composite welding mechanism, Phase I Briefing Chart Image

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Organizations Performing Work	Role	Type	Location
ATSP Innovations	Lead Organization	Industry	Champaign, Illinois
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

## Primary U.S. Work Locations

Illinois	Virginia
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## Images



## Briefing Chart Image

Interchain transesterification as a solid-state composite welding mechanism, Phase I Briefing Chart Image  
(<https://techport.nasa.gov/image/135994>)

## Organizational Responsibility

## Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

## Lead Organization:

ATSP Innovations

## Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

## Program Director:

Jason L Kessler

## Program Manager:

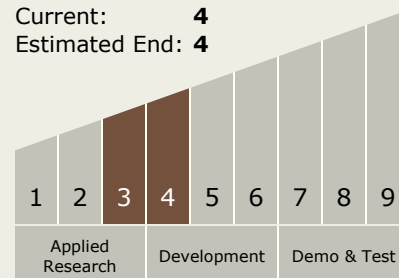
Carlos Torrez

## Principal Investigator:

Jacob Meyer

## Technology Maturity (TRL)

Start: 3  
Current: 4  
Estimated End: 4



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## Technology Areas

### Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - └ TX12.1 Materials
    - └ TX12.1.1 Lightweight Structural Materials

## Target Destinations

Earth, The Moon, Others Inside the Solar System, Outside the Solar System, The Sun, Mars